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A Study of Persistence in College Attendance in Relation to Placement-Test Scores and Grade-Point Averages

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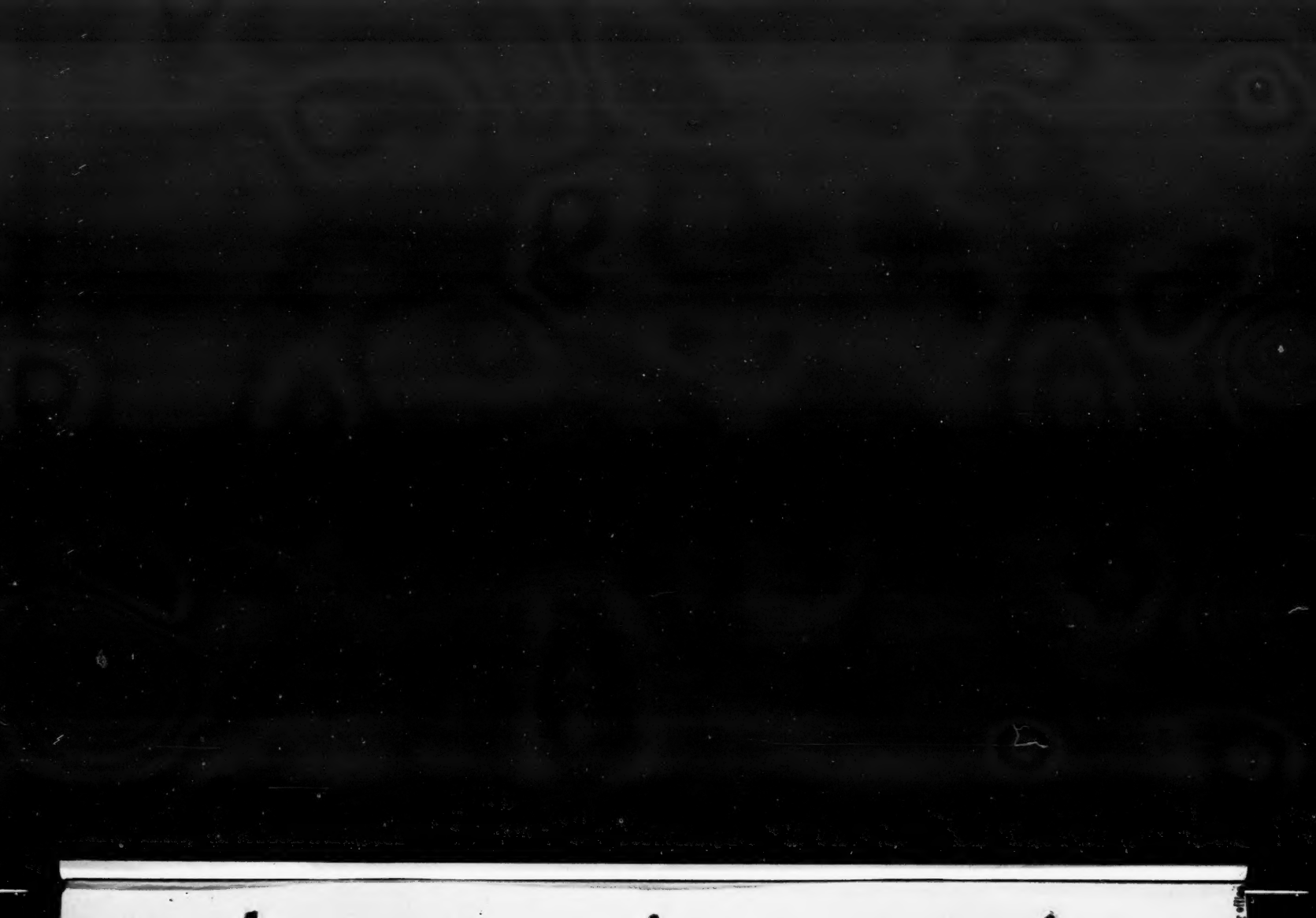

A Study of Persistence in College Attendance in Relation to Placement-Test Scores and Grade-Point Averages

MILO O. STUCKY AND KENNETH E. ANDERSON

PART I
Purpose of the Study

INTRODUCTION

One of the great problems facing the American people now, and in the near future, is the question of who shall and must be educated at the college and university level in order that our democratic way of life can be preserved and sustained in vigor and vitality for the future.

It has been rather commonly accepted that every young person in our land has the right to as much formal education as he desires and finds economically feasible. The public schools and institutions of higher learning have been open to all comers. They stand as vehicles of opportunity for every young American to use in reaching the realization of his birthright. There are many educational leaders of our day who point out that the purposes of higher education are not merely to educate the leaders for technological, economic, and scientific enterprises, but also to convey to the average individual a "point of view" which is as necessary to perpetuate and improve our way of life, as is the highly complex specific body of knowledge which must be imparted to the scientific, business, and cultural leaders of our society. Smith, in his recent study on college admission, points out that education must be available not only for those who generate the impact of new things but also for those who, in greater numbers, are the recipients of that impact.[1]

Perhaps a university education does not help one to meet successfully the steadily mounting tensions of life. However, it may not be amiss to assume that trained minds do enable people, and will con-

[1] George B. Smith. "Who Would Be Eliminated? A Study of Selective Admission to College." *Kansas Studies in Education,* 7 (December, 1956) 1-28.

tinue to enable them to make decisions which are wiser than those made by untrained minds. This premise, along with others, is one that we can not lightly reject or cast aside.

People enroll in college for various reasons. Most of them, we like to assume, enroll because they have a well-directed plan to continue and further their education to the end that they may be trained to enter professions or vocations of their choice. It is quite probable, however, that many young men and women enroll in college because of other reasons less defined and less laudatory. They go because of parental pressure, because their friends go, because of a reluctance to go to work, or because of the inability to find employment; or because it is the "thing to do." These young people who are in college as a result of some aspect of social pressure rather than for a well-defined purpose, will probably show less persistence in their stay in college because of lack of basic motivation.

Colleges are now being increasingly faced with the problem which has faced secondary schools for a generation. During recent months criticism of the secondary program has reached a crescendo on the basis of the claims made that there is real and far-reaching lack of academic attainment. The dilemma, which has been facing the secondary schools, is that of maintaining vigorous academic requirements on one hand and accommodating all youth, regardless of ability, on the other. The American dream of universal education has put the secondary schools in the position where they must diversify their offerings so that every student will be challenged to use his capabilities, or the school must continue to issue diplomas to many as mere certificates of attendance.

In 1955-56 over 30 per cent of the boys and girls of college age in Kansas were in college. The figure rises each year. Looking ahead, college administrators ask whether they must plan for universal enrollments, such as those which struck secondary schools a generation ago. Of course the colleges themselves are not alone in facing the problem. The people must decide if they can afford to make a college education available to all. They must decide on the bases of belief and sound data whether it is necessary to provide every young man and woman the opportunity to secure a college education. If it is found that universal higher education is needed for survival, it must be paid for. At the present time the American people have no central belief nor is sound information available. Pending its availability, college administrators must plan on the basis of information at hand. Not all students

who enter college persist in attendance. The rate of attrition varies. Efforts must be made to identify, in terms of as many criteria as possible, the persistence patterns of students who enroll in college, so that accommodating educational planning may be accomplished.

It may be well to note that no inference is being made that many young men and women fail to realize their purposes in enrolling and attending college for varying periods of time less than the four years usually required for a degree. Many succeed during a relatively short stay in college in making the necessary contacts which enable them to leave with satisfaction. They get what they came for. For most, however, a college education is desired for its cumulative effect, and those responsible for the organization of higher institutions of learning must plan for the ideal termination of college careers in terms of courses completed and degrees earned.

In either short- or long-term planning, it would seem to be advantageous for college administrators to have some knowledge of why some students persist in college and some terminate their college careers at various stages short of graduation.

To the present time, so far as can be found, very little effort has been expended to find cause and effect relationships of persistence in college attendance. The components which go together to formulate the quality of persistence are largely unknown, whether they be factors of circumstances attendant to school life or whether they be primarily found within the individual. Planning of educational facilities and practices might be facilitated if definite patterns of persistence in college attendance could be observed and recorded.

Statement of Purpose

The present investigation was a study of persistence in college attendance in relationship to placement-test scores and grade-point averages.

The group of students under consideration consisted of 1237 freshmen who entered the University of Kansas in the fall of 1954. Assuming normal progress, these students graduated in the spring of 1958. This study, however, is limited to the first five semesters of the group's attendance at the University. The semesters considered in the study are those of the fall of 1954, the spring of 1955, the fall of 1955, the spring of 1956, and the fall of 1956.

The pertinent factors under consideration were the eight placement-test scores and grade-point averages for the five semesters. The

placement examinations will be identified in Part II. These examinations were administered prior to admission to the University.

Specific Statement of Purpose

Specifically, the purpose of the study may be stated in terms of five problems:

1. To determine the existence of significant differences in the means of the placement-test scores of those who attended the University one, two, three, four, and five semesters.

2. To determine the existence of significant differences in mean grade-point averages for the first semester of those who attended the University one, two, three, four, and five semesters.

3. To determine the existence of significant differences in mean grade-point averages for the second semester of those who attended the University two, three, four, and five semesters.

4. To determine the existence of significant differences in mean grade-point averages for the third semester of those who attended the University for three, four, and five semesters.

5. To determine the existence of significant differences in mean grade-point averages for the fourth semester of those who attended the University for four and five semesters.

Each of the five problems discussed above may be stated as a statistical hypothesis in the form of a null hypothesis.

For example, in Problem One, the null hypothesis under test was: There were no significant differences among the means of the five groups of students on each of the placement examinations.

Summary

Faced with increased enrollment, college and university administrators need to plan for student accommodation on the basis of expected persistence in attendance as well as on the basis of other considerations. Such planning might be facilitated if persistence patterns could be established. The present study follows the attendance of a freshman class through five semesters of attendance at the University of Kansas and investigates the existence of significant differences among the means of placement-test scores and among the means of grade-point averages of the various groups of students, depending upon the number of semesters they remained in attendance.

PART II
Sources of Data

Introduction

The present study[2] was one of a series of studies being planned, or already accomplished, dealing with the freshman class which entered the University of Kansas in the Fall of 1954.[3] The scope of the over-all investigation, when completed, is to include such problems as the following: (1) A study of exceptional students. (2) Factors of academic success in college. (3) Incidence and pertinence of extra-curricular activities in college as they pertain to student success. (4) Causes of drop-outs. (5) Follow-up of drop-outs. (6) Follow-up of graduates.

One specific project which may well follow the present work is a projection of the significance of grade-point averages and placement-test scores in academic success.

Before and at the time of enrollment of the entering class under consideration, various types of information had been acquired which should serve as valuable data for further study.

Selection of Study Group

In the Fall of 1954, the records showed that over-all, a total of 1242 freshmen enrolled in the University of Kansas. The entire group was the subject of this project. Therefore there was no problem of sampling. Of these 1242 enrollees, there were some who, for one reason or another, failed to take one test or another, and of the total number, 1237 had grades recorded to their credit for the first semester in attendance (Fall Semester, 1954). The breakdown of the number of students who were recorded with test scores for the various tests is shown in Table 1. The number of students who persisted in attendance for each of the five semesters, as described in Part I, varied slightly with the type of placement test, as will be shown in the next section. In addition, the number taking each of the several tests was in slight variance with the number for which grades were recorded for

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[2] Milo O. Stucky. Unpublished dissertation submitted to the Department of Education and to the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Education. February, 1959.

[3] Kenneth E. Anderson. *University of Kansas: General Research Project Number 3248-5038.*

TABLE 1

NUMBER OF STUDENTS TAKING THE VARIOUS PLACEMENT TESTS LISTED BY SEMESTERS IN ATTENDANCE, AND NUMBER OF STUDENTS FOR WHICH GRADE POINT AVERAGES WERE COMPUTED BY SEMESTERS IN ATTENDANCE

Placement Test	One Semester			Two Semesters			Three Semesters			Four Semesters			Five Semesters			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
ACE-Q	41	37	78	125	109	234	60	26	86	158	92	250	363	210	573	747	474	1221
ACE-L	43	37	80	124	110	234	59	26	85	158	92	250	365	210	575	749	475	1224
ACE-T	41	37	78	124	109	233	59	26	85	158	92	250	364	209	573	746	473	1219
CRT-S	44	37	81	124	109	233	57	26	83	158	93	251	365	210	575	748	475	1223
CRT-V	39	37	76	127	108	235	57	26	83	159	93	252	365	210	575	747	474	1221
CET-S	39	37	76	123	110	233	59	26	85	159	91	250	364	208	572	744	472	1216
CET-U	41	38	79	125	110	235	59	26	85	160	93	253	365	210	575	750	477	1227
K.U-M	43	37	80	125	110	235	57	26	83	159	91	250	353	208	561	737	472	1209
G.P.A.	43	38	81	127	110	237	60	26	86	164	94	258	365	210	575	759	478	1237

each of the five semesters. This difference, however, was so slight as to be negligible.

Examinations Used in the Study

A battery of four placement examinations has been employed for a number of years at the University. They were administered to the entering class in the fall of 1954 and the scores were used for a substantial portion of this study.

The names of the tests, with the separate sets of scores, were as follows:

1. *American Council on Education Psychological Examination,* Quantitative, Linguistic, and Total scores. The examination is designed especially for college freshmen and is recommended as a device for appraising general intelligence.

2. *Mathematics Test for Entering Students, University of Kansas.* The examination has a single score, but has parts devoted to testing ability in arithmetic, geometry, and algebra separately.

3. American Council on Education: *Cooperative English Test, Test C2: Reading Comprehension,* Vocabulary and Speed scores. A third score for comprehension was not employed, since it is not scored in the University testing program.

4. Educational Testing Service: *Cooperative English Test,* Usage and Spelling scores. A third score, for vocabulary, was not used, since one vocabulary score was already available.

For easy reference, the eight sets of scores were abbreviated, respectively, as ACE-Q, ACE-L, ACE-T, KU-M, CRT-V, CRT-S, CET-U, and CET-S.

Grade-Point Averages

The academic achievement of the students in this study was measured in terms of grade-point averages derived from the grades during five semesters of attendance. The grades used were those recorded in January, 1955; June, 1955; January, 1956; June, 1956; and January, 1957. Withdrawals and re-entries were not regarded. Each student's grades were processed and labeled for the order of the semester that particular student was in attendance at the University of Kansas.

In order that the computations might be facilitated, a slightly different set of numerical values was given to grades, from what is customarily used at the University. This method is shown in Table 2.

TABLE 2

ASSIGNMENT OF NUMERICAL VALUES TO LETTER GRADES

Letter Grade	Numerical Value Ordinarily Employed	Numerical Value Employed in Study
A	3	4
B	2	3
C	1	2
D	0	1
F	-1	0

EVOLVEMENT OF GRADE-POINT AVERAGE

Course Number	Course Grade	Points Per Hour	Hours Credit Per Course	Points Per Course
1	A	4	3	12
2	B	3	3	9
3	F	0	2	0
4	C	2	5	10
5	D	1	3	3
Total --	--	--	16	34

G.P.A. = 34/16 = 2.12

Grade-point averages are derived by multiplying the pointed weight for a given grade by the number of hours of credit given in the course in which the given grade was earned. The number of products, thus derived, correspond to the number of courses for which grades have been submitted. The sum of these products is then divided by the total number of hours attempted, the quotient being the grade-point average for the semester. A simple computation is also shown in Table 2. The number of grade-point averages derived and credited to students for the various semesters have been shown in Table 1.

SUMMARY

Of the 1242 students enrolled at the University of Kansas in the Fall of 1954, 1237 had grades assigned to them at the end of the first semester, 1156 students received grades at the end of the second semester, 919 were alloted grades at the end of the third semester, 833 received grades at the end of the fourth semester, and there were 575 who had grades recorded for them at the end of the fifth semester. Thus we see that less than half of the students of the study who began the first semester were still in attendance at the end of the fifth semester.

Eight placement-test scores were obtained from this body of students with a very slight variation from the total number of grade-point averages, due to the fact that a very small number of students, for one reason or another, completed courses and received grades, but missed taking one or more of the placements tests or parts of tests. This number is so small as to be negligible. The data thus obtained were the basis for the findings described in the following sections of this report.

PART III
Analysis of the Data

PRELIMINARY TREATMENT OF PLACEMENT-TEST SCORES

In Part I it was pointed out that the hypotheses under test could all be stated in terms of the null hypothesis. If the technique of analysis of variance had been used for testing differences in means, each hypothesis would have read: Are these groups random samples from the same normal population? However, as will be described, the technique of chi-square was used, which does not require the assumption of normality.

Nevertheless, it was deemed important to report certain statistics on each placement-test distribution for the entire group of students as given in Tables 3, 4, and 5. Raw scores were used in the calculation of these various statistics and in the calculation of other statistics used in the study. As indicated in Table 1, there was a slight variance in the number of students who took each of the placement tests, the number varying from 1209 who had scores recorded for the KU-M test, to 1227 who received scores for the CET-U test.

An examination of the tables shows that departure from the normal in terms of skewness varied with the tests. The test scores of the males were positively skewed in three of the tests, and negatively skewed in

TABLE 3

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS OF PLACEMENT TEST SCORES FOR ENTERING MALES

	Males									
Placement Test	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
ACE-Q	747	47.54	48.42	11.01	60.69	33.37	55.12	40.28	-.239	.271
ACE-L	749	65.29	65.17	14.25	83.40	47.67	75.29	61.50	.025	.193
ACE-T	746	112.76	114.08	22.50	139.18	85.34	128.70	98.79	-.176	.277
CRT-S	748	28.47	27.50	14.10	46.60	10.67	37.34	17.91	.208	.270
CRT-V	747	30.92	31.02	11.13	45.22	16.06	39.42	23.22	-.026	.277
CET-S	744	16.39	15.00	9.88	30.40	4.21	23.16	8.59	.422	.278
CET-U	750	90.11	90.25	29.19	126.30	50.78	112.51	67.76	-.014	.296
KU-M	737	52.96	54.96	13.17	68.61	33.85	63.48	44.73	-.455	.269

TABLE 4

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS OF PLACEMENT-TEST SCORES FOR ENTERING FEMALES

Placement Test	Females N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
ACE-Q	474	43.31	47.05	10.71	58.95	28.55	51.00	36.33	-1.047	.241
ACE-L	475	66.46	65.94	16.60	89.31	45.87	76.31	55.09	.093	.244
ACE-T	473	109.92	111.01	24.50	140.92	79.58	124.43	94.01	-.133	.247
CRT-S	475	29.87	27.77	15.63	50.37	11.05	39.25	19.26	.404	.254
CRT-V	474	31.91	31.80	11.37	47.07	15.99	39.57	23.26	.029	.262
CET-S	472	21.11	20.36	10.24	35.31	7.40	29.50	13.17	.219	.292
CET-U	477	106.38	108.76	27.65	139.62	66.19	126.86	90.01	-.258	.250
KU-M	472	43.73	44.04	12.42	60.96	27.08	53.86	35.30	-.074	.273

TABLE 5

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS OF PLACEMENT-TEST SCORES FOR ENTERING STUDENTS

Placement Test	Total Students									
	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
ACE-Q	1221	45.89	48.40	11.10	61.39	32.56	55.45	39.63	-.675	.274
ACE-L	1224	65.74	65.43	15.15	85.47	47.16	75.78	55.33	.061	.266
ACE-T	1219	111.73	113.00	23.35	139.51	82.41	127.11	96.95	-.163	.264
CRT-S	1223	29.01	27.42	14.73	47.29	10.68	37.66	18.39	.325	.263
CRT-V	1221	31.18	31.37	11.22	46.04	16.02	39.47	23.23	-.051	.270
CET-S	1216	18.22	16.94	10.28	32.60	5.11	25.85	10.20	.373	.284
CET-U	1227	96.43	98.72	29.68	133.87	54.49	117.77	75.70	-.232	.265
KU-M	1209	49.52	50.50	13.71	67.11	30.19	60.39	39.43	-.212	.285

five of the tests. The test scores of the females were skewed positively in four tests, and negatively skewed in four tests. When males and females were combined for totals, the distributions were skewed positively in three tests, and negatively in five tests. Negative skewness was to be expected as the number of semesters attended increased. This was due to the attrition and subsequent piling up of the scores toward the tops of the distributions.

It may be noted that the test scores of the females were leptokurtic in six of the eight distributions, while the tests scores of the males were platykurtic in seven of the eight distributions. When male and female scores were combined for totals, all the distributions were platykurtic with the exception of the CRT-S test. That test distribution was normal in terms of kurtosis. The significance of the departure in terms of skewness and kurtosis from the normal was not calculated for the eight tests for the categories, male, female, and totals. The purpose of the study was not specifically the calculation of F and t ratios for particular comparisons. It is well to note, however, as far as the placement tests are concerned, the females tended to cluster around their means more closely than the males tended to cluster around their means. In other words, there was a tendency for the males to be more variable than the females on their eight placement tests. The standard deviations reported tend to support this statement.

Also, it was thought highly desirable, for informative purposes, to calculate the statistics showing measures of central tendencies, variability, skewness, and kurtosis for each of the five groups, distinguished from each other by the number of semesters in attendance at the University, for the eight placement tests. This information is reported only for the ACE-Q, ACE-L, and ACE-T, in Appendix Tables 1, 2, and 3.

For the most part the means on all of the tests increased progressively, as recorded by groups, according to their continued attendance at the University. That is, in general, the more persistent groups scored progressively higher in terms of mean scores than the less persistent groups on the eight placement tests. There were some exceptions to this tendency, five among the males, four among the females, and two when the test scores for males and females were combined for totals. These eleven exceptions occurred in a total of 96 series of progressive semesters covered in this study. This number was obtained by the consideration that the three classifications, males, females, and total students, progressed through five semesters, and thus increased their semesters in attendance by four, in each category.

Preliminary Treatment of Grade-Point Averages

As will be described, the technique of chi-square was used to test for differences in means in grade-point averages for: (1) the first semester for the five groups of students who attended the University one, two, three, four, and five semesters; (2) the second semester for the four groups of students who attended the University two, three, four, and five semesters; (3) the third semester for the three groups of students who attended the University three, four, and five semesters; and (4) for the two groups of students who attended the University for four and five semesters.

Preliminary to the examination of the grade-point averages of student groups identified by numbers of semesters in attendance, it was deemed desirable to report the measures of central tendencies, variability, skewness, and kurtosis for the entire groups of males, females, and total students, who were the objects of this study. It will be seen from Table 1 that 1237 students received grades for the first semester. This number was made up of 759 males and 478 females. Table 6 shows the number of drop-outs and the percentages of drop-outs for the various semesters. Thus it is seen that a greater attrition occurred, as expected, between academic years than between fall and spring semesters. The heaviest total drop occurred after the fourth semester, the lightest, after the first. More women, however, quit after one semester than after four. Both sexes suffered an attrition of over 50 per cent between the first and fifth semesters, the total percentage of drop-outs being 53.5 over-all, from semester one to five.

By examining Table 7 it is found that both the means of males and females increased for each successive semester, with one exception. The mean average for females for the fourth semester was 2.673, which was lower than the third semester mean of 2.687. For the five semesters the mean for the males increased almost a quarter of a grade-point, or .240. The mean for the females increased over a half of a grade-point, or .541. The total student increase in mean grade-point average over five semesters was .345.

There was one characteristic of scores which carried through without a single exception. In every case the female averages were higher than the counterpart male averages. This held true for every semester, and for every measure calculated.

The distributions were negatively skewed with three exceptions, the three-semester male, the four-semester female, and the three-semester total student distributions.

TABLE 6
ATTRITION TABLE

Semester	Males			Females			Total Students		
	No. in Attendance	No. of Drop-Outs	Per Cent of Drop-Outs	No. In Attendance	No. of Drop-Outs	Per Cent of Drop-Outs	No. In Attendance	No. of Drop-Outs	Per Cent of Drop-Outs
1	759	43	5.7	478	38	7.9	1237	81	6.5
2	716	127	17.7	440	110	25.0	1156	237	20.5
3	589	60	10.2	330	26	7.8	919	86	9.9
4	529	164	31.0	304	94	30.9	833	258	31.1
Total			51.9			56.1			53.5

TABLE 7

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS OF GRADE-POINT AVERAGES FOR ENTERING STUDENTS

Semester	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
1	759	2.190	2.206	.83	3.269	1.053	2.796	1.607	-.072	.268
2	716	2.221	2.256	.84	3.279	1.086	2.801	1.676	-.142	.255
3	589	2.369	2.289	.78	3.291	1.225	2.882	1.728	.307	.265
4	529	2.386	2.390	.78	3.392	1.443	2.918	1.957	-.015	.246
5	365	2.430	2.474	.81	3.521	1.370	2.977	1.914	-.148	.248
					Females					
1	478	2.327	2.372	.83	3.551	1.147	2.935	1.867	-.180	.220
2	440	2.413	2.441	.80	3.424	1.319	3.028	1.973	-.112	.252
3	330	2.687	2.689	.66	3.545	1.898	3.179	2.258	-.006	.278
4	304	2.673	2.663	.64	3.465	1.900	3.128	2.292	.046	.269
5	210	2.868	2.870	.56	3.608	2.145	3.261	2.525	-.053	.253
					Total Students					
1	1237	2.245	2.270	.83	3.271	1.087	2.861	1.703	-.108	.266
2	1156	2.294	2.324	.83	3.051	1.164	2.894	1.783	-.108	.293
3	919	2.462	2.452	.77	3.423	1.394	2.988	2.005	.038	.241
4	833	2.491	2.513	.74	3.424	1.563	3.022	2.068	-.081	.255
5	575	2.590	2.656	.76	3.560	1.572	3.108	2.125	-.236	.246

Six of the distributions were leptokurtic, and nine were platykurtic, the flattest curve being that of the two-semester total-student distribution, and the most peaked being that of the one-semester female distribution.

Again, it was considered important to report the measures of central tendency, variability, skewness, and kurtosis for the students who attended one, two, three, four, and five semesters. These statistics appear in the Appendix in Tables 4 to 8, showing five groups for the first semester, four groups for the second semester, three groups for the third semester, two groups for the fourth semester, and one group for the fifth semester.

For the sake of clarity, let it be known that the five groups under consideration, being classified according to the length of their stay at the University, were labeled as follows: Those who stayed only one semester were called one-semester students, those who stayed two semesters were called two-semester students, those who remained three semesters were called three-semester students, those who remained four semesters were called four-semester students, and those who were in attendance five semesters were called five-semester students. Persumably most of the five-semester students stayed for more than five semesters, but in doing so they moved out of the range of this present investigation.

It would be expected that for each semester the means of grade-point averages would increase for each group of students classified according to length of stay. Such was found to be the case without a single exception. For each semester, the groups which were to remain for progressively more semesters recorded higher mean grade-point averages. In fact, with but six exceptions, this was true not only for means, but for all the values recorded for grade-point averages, such as medians, and tenth, twenty-fifth, seventy-fifth, and ninetieth percentile scores. This fact points up a rather striking indication of the relationship between grade-point averages and length of stay in school. The tables under consideration show a total of 45 distributions, 15 for the first semester, 12 for the second, 9 for the third, 6 for the fourth, and 3 for the fifth. These 45 distributions afforded opportunity for 30 instances of progression in central tendencies. Considering that we are dealing with six different measures in each distribution, we have a grand total of 180 instances in which the expected might not happen. It was rather remarkable that it did happen in all but six instances.

Testing for Significance of Differences in Means

The differences in means for any one analysis, such as differences in means of the placement-test scores of students who attended the University one, two, three, four, or five semesters, could have been tested by using the technique of analysis of variance. This would have necessitated obtaining the ΣX's and the ΣX^2's of the various distributions, which in itself would have been a tremendous task. More significantly, this was judged to be unnecessary in view of the procedure[4] chosen for the purpose at hand, both from the standpoint of time used and results obtained. Also, the variation in departure from normality of the various distributions would have violated one of the assumptions underlying the technique of analysis of variance.

A comparison of the results obtained by using the analysis of variance method with results obtained by the use of Leslie's method on the CRT-V test, resulted in the same conclusion that the five groups differed significantly as to means. Reconstruction of the sum of squares from the standard deviations and application of the analysis of variance method produced an F of 17.51 significant at the 1 per cent level. Application of Leslie's method to the five distributions for the CRT-V test yielded a chi-square value of 5.07 as shown in Table 8. Since the probability value of 5.07 is less than .2 in 1000, it was concluded that signficant differences in means did exist among the five semester groups on the CRT-V test for total students. Thus it was decided to use the frequency distribution of scores for each of the groups, and to run an over-all test of homogeneity of frequency distributions, using the method described by Leslie.

If the chi-square test used in Leslie's method indicates non-homogeneity of freqency distributions, then some test is in order to determine significant differences in means. The test used in the study in this connection will be described below.

First, let us illustrate the application of Leslie's method, using five distributions as shown in Appendix Table 9. The samples chosen consisted of the placement-test scores on the ACE-T test for all students in the study who attended the University one, two, three, four and five semesters. Appendix Table 9 shows the F's and the F^2's for the five distributions. Also the N's and 1/N's are shown for the rows and

[4] P. H. Leslie. "The Calculation of Chi-Square for an r by c Contingency Table." *Biometrics*, 7 (September, 1951) 283-286.

TABLE 8
HOMOGENEITY OF FREQUENCY DISTRIBUTIONS
FOR PLACEMENT-TESTS

Group	Chi-Square	Degrees of Freedom	Probability
	ACE-Q TEST		
Males	5.09	92	P<.0002
Females	0.01	92	P>.05
Total Students	4.10	92	P<.0002
	ACE-L TEST		
Males	3.41	80	P<.0006
Females	1.29	80	P>.05
Total Students	2.94	80	P<.0004
	ACE-T TEST		
Males	4.26	116	P<.0002
Females	2.73	116	P<.007
Total Students	8.45	116	P<.0002
	CRT-S TEST		
Males	0.27	116	P>.05
Females	1.95	116	P>.05
Total Students	3.93	116	P<.0002
	CRT-V TEST		
Males	2.32	76	P>.02
Females	2.77	76	P<.006
Total Students	5.07	76	P<.0002
	CET-S TEST		
Males	0.75	96	P>.05
Females	2.90	96	P<.004
Total Students	1.87	96	P>.05
	CET-U TEST		
Males	0.24	100	P>.05
Females	1.67	100	P>.05
Total Students	6.71	100	P<.0002
	KU-M TEST		
Males	7.30	88	P<.0002
Females	3.75	88	P<.0002
Total Students	3.20	88	P<.02

columns. The next step in the application of Leslie's method for homogeneity is shown in Appendix Tables 10 to 14 for each of the five semester groups. The sum of the products from Appendix Tables 10 to 14, inclusive, was obtained. The sum totaled 1.2295.

The application of the chi-square formula suggested by Leslie is shown below:

$$X^2 = N\left[\Sigma\ (F^2)\ \left(\frac{1}{Tr}\right)\ \left(\frac{1}{Tc}\right) - 1\right]$$

$$X^2 = 1219\ (1.12295 - 1.000)$$

$$X^2 = 279.7605$$

In this case the number of rows was 30 and the number of columns was 5. Therefore, the number of degrees of freedom was equal to (r-1)(c-1), or 29x4, or 116. Since the degrees of freedom exceed 30, it was necessary to use the formula for chi-square ordinarily used in connection with the normal probability table.

The application of this formula is shown below:

$$z = \sqrt{2X^2} - \sqrt{2(\text{d.f.}) - 1}$$

$$z = \sqrt{2(279.7605)} - \sqrt{232 - 1}$$

$$z = \sqrt{559.5210} - \sqrt{231}$$

$$z = 23.65 - 15.20$$

$$z = 8.45$$

Reference to the normal probability table indicates that a z value of 8.45 could not have occurred by chance alone except .2 times or less in 1000. Therefore, it was concluded that the five frequency distributions were not homogeneous and that the means of the five groups did differ significantly from each other.

In order to locate significant differences in means, it was necessary to calculate the standard error of each mean, and set up the fiducial limits of each mean at the 5 per cent level. The standard error of each mean was obtained by using the following formula:

$$\text{SE mean} = \frac{S}{\sqrt{N-1}}$$

where S is the standard deviation of the sample.

In the case of Group I, Appendix Table 9, the standard deviation as shown in Appendix Table 3 was 24.10 with 78 cases. The standard error was thus computed to be:

$$\text{SE mean} = \frac{24.10}{\sqrt{78\text{-}1}}$$

$$\text{SE mean} = \frac{24.10}{\sqrt{77}}$$

$$\text{SE mean} = \frac{24.10}{8.77}$$

$$\text{SE mean} = 2.75$$

The fiducial limit of the mean for Group I was calculated, using the following method.

$\overline{X} \pm (\text{SE mean})(1.96) = \text{Lower limit or Upper limit.}$

$\overline{X} - (2.75)(1.96) = 98.35 - 5.39 = 92.96$, or the lower limit.

$\overline{X} + (2.75)(1.96) = 98.35 + 5.39 = 103.74$, or the upper limit.

The limits, 92.96 and 103.74, indicate that, in repeated sampling, the true mean of the ACE-T test for students attending the University one semester only, would fall between these limits 95 times out of 100.

Table 9 shows the standard error of each mean of the five groups on the ACE-T test, as well as the fiducial limits of each mean. On the basis of the data in Table 9, it was concluded that the means of Groups 4 and 5 were significantly higher than the means of Groups 1, 2, and 3. Also, that the means of Groups 4 and 5 did not differ significantly from each other. The same was true regarding the means for Groups 1, 2, and 3. The situation is shown diagrammatically in Figure 1.

The diagram in Figure 1 shows there was overlapping among Groups 1, 2, and 3, and that the means did not differ significantly from each other. The same statement held true for Groups 4 and 5. Since there was no overlapping between Groups 1, 2, and 3 on the one hand, and Groups 4 and 5 on the other, there was a significant difference in the means between the two sets of groups A and B as indicated in the diagram.

The question might well be raised that if analysis of variance had yielded a significant F value, would it not have been necessary to raise

TABLE 9

STANDARD ERROR AND FIDUCIAL LIMIT OF EACH MEAN FOR THE ACE T TEST FOR STUDENTS ATTENDING THE UNIVERSITY FOR THE NUMBER OF SEMESTERS INDICATED

Group by Total Semesters in Attendance	M	SE $\bar{X}$	Fiducial Limits of the Means at the 5 Per Cent Level
1	98.35	2.75	92.96 - 103.74
2	100.13	1.62	96.95 - 103.31
3	106.29	2.17	102.04 - 110.54
4	114.72	1.35	112.07 - 117.37
5	116.79	0.90	116.03 - 119.55

Groups 4 and 5 differ significantly from Groups 1, 2, and 3.

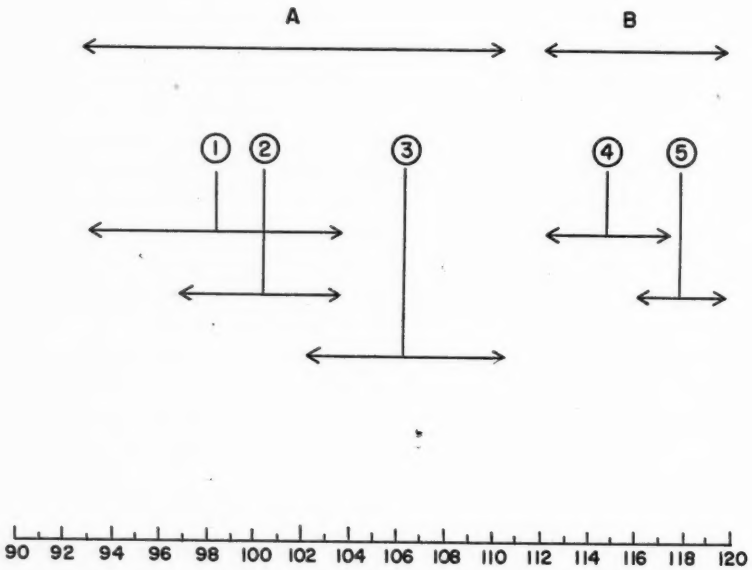

FIGURE 1. *Fiducial Limit of Each Mean for the ACE-T Test*

the probability values for each of the ten t-tests to 1 in 10(100) or 5 in 10(100) to claim significant differences in means? The point is well taken, but the significant chi-square values in Tables 8, 18, 19, 20 and 21, had for the most part extremely low probability values. Fourteen significant chi-square values at the 1 per cent level out of 24 were attained for the placement-test comparisons. Eight significant chi-square values at the 1 per cent level out of 12 were obtained for the grade-point average comparisons. The chance probability of obtaining this many significant values is less than .001[5]. This coupled with the fact that the isolation of trends was the main purpose of the study led the investigators to use the 5 per cent level in establishing limits. The 1 per cent level or higher could have been used to establish fiducial limits, but the five per cent level was chosen and Duncan's method yielded essentially the same results at this level. These qualifications must be kept in mind when the results of the study are examined.

The question arises if the application of the method advocated by Duncan[6] would have yielded the same general results as did the standard error method as used. For a comparison of the two methods, the CRT-V test for total students, for which the computations are shown in Tables 8 and 14, was again used.

Application of Duncan's method, called the New Multiple Range Test, using significant studentized ranges for the 5 per cent and 1 per cent levels, is illustrated below.

The test assumes that the observed means were drawn independently from N normal populations where the true means have a common standard error. The standard errors were not tested for homogeneity. In our case, we can only estimate the standard error of each mean from the sample. These were (table 14): Group 1=1.42; Group 2=0.72; Group 3=1.20; Group =0.65; Group 5=0.46. The standard deviations used in computing the standard errors were homogeneous. However, since Duncan's method calls for one standard error, the harmonic mean of the five was computed as follows:

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[5] James M. Sakoda, Burton H. Cohen, and Geoffrey Beall. "Test of Significance for a Series of Statistical Tests." *Psychological Bulletin,* 51 (March, 1954) 172-175.

[6] David S. Duncan. "Multiple Range and Multiple F. Tests." *Biometrics,* 7 (March, 1955) 1-42.

$$H=\frac{K}{\Sigma\left(\frac{1}{1.42}+\frac{1}{0.72}+\frac{1}{1.20}+\frac{1}{0.65}+\frac{1}{0.46}\right)}$$

$$H=\frac{5}{6.6388}=.753$$

Using Duncan's tables, we have:

	2	3	4	5	
P	2.77	2.92	3.02	3.09	5 per cent level
R_p	2.09	2.20	2.27	2.33	
	2	3	4	5	
P	3.64	3.30	3.90	3.98	1 per cent level
R_p	2.74	2.89	2.94	3.00	

The R_p's were found by multiplying P by the harmonic standard error of the mean.

The next step was to obtain the following differences in means:

33.08—25.79=7.29 (Group 5 versus Group 1)
33.08—27.51=5.57 (Group 5 versus Group 2)
33.08—27.29=4.79 (Group 5 versus Group 3)
33.08—32.85=0.23 (Group 5 versus Group 4)

32.85—25.79=7.06 (Group 4 versus Group 1)
32.85—27.51=5.34 (Group 4 versus Group 2)
32.85—28.29=4.56 (Group 4 versus Group 3)

28.29—25.79=2.50 (Group 3 versus Group 1)
28.29—27.51=0.78 (Group 3 versus Group 2)

27.51—25.79=1.72 (Group 2 versus Group 1)

Comparing these differences with the R_p's for the five and one per cent levels, we note that at the five per cent level: (1) Groups 4 and 5 were not different. (2) Groups 4 and 5 were superior to Groups 1, 2, and 3. (3) Group 3 was superior to Group 1, but not to Group 2. (4) Group 2 was not superior to Group 1.

We note at the 1 per cent level: (1) Groups 4 and 5 were not different. (2) Groups 1, 2, and 3 were not different. (3) Groups 4 and 5 were superior to Groups 1, 2, and 3.

Thus we obtain essentially the same conclusions as with the standard error method. Since the standard error method yielded essentially

the same results as Duncan's method, it was decided to use the more commonly understood standard error method for obtaining fiducial limits of the means.

Application of Methods Illustrated to all Placement-Test and Grade-Point Average Distributions

The same procedure, as has been described for the ACE-T test in the preceding pages, was carried out for all of the eight placement-test distributions under consideration, and also for all grade-point average distributions by students in attendance at the University for the five semesters covered in this study.

Table 10

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE ACE-Q TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
1	40.29	1.58	37.19 - 43.39
2	42.64	1.13	40.43 - 44.85
3	45.15	1.27	42.06 - 47.64
4	48.28	.76	46.79 - 49.77
5	50.12	.54	49.06 - 51.18
Group 4 differs significantly from Groups 1 and 2. Group 5 differs significantly from Groups 1, 2, and 3.			
	Females		
No significant differences in means.			
	Total Students		
1	40.31	1.30	37.76 - 42.86
2	41.23	.78	39.70 - 42.76
3	44.78	1.07	42.68 - 46.88
4	46.65	.63	45.42 - 47.88
5	48.41	.44	47.55 - 49.27
Group 4 differs significantly from Groups 1 and 2. Group 5 differs significantly from Groups 1, 2, and 3.			

TABLE 11

SIGNIFICANCE OF DIFFERENCE IN MEANS ON THE ACE-L TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
1	57.49	2.21	53.16 - 61.82
2	48.68	1.24	56.25 - 61.11
3	60.27	1.66	57.02 - 63.52
4	68.08	1.03	66.06 - 70.10
5	68.38	.70	67.01 - 69.75
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			
	Females		
No significant differences in means.			
	Total Students		
1	57.56	1.69	54.25 - 60.87
2	59.26	1.03	57.24 - 61.28
3	61.12	1.50	58.18 - 64.06
4	67.60	.89	65.86 - 69.34
5	69.40	.59	68.24 - 70.56
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			

The subsequent analyses of the results for the placement tests appear in Tables 10 to 17. Note should be taken that only those situations in which significant chi-square values were obtained have been shown in Tables 10 to 17, with the corresponding fiducial limits.

The chi-square values and the corresponding probabilities as computed by the use of Leslie's method, and as demonstrated for the ACE-T test in the preceding pages, are shown for all the placement-test distributions in Table 8.

TABLE 12

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE ACE-T TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
1	98.22	3.54	91.28 - 105.16
2	101.31	2.16	97.08 - 105.54
3	105.47	2.47	100.63 - 110.31
4	115.92	1.65	112.69 - 119.15
5	118.37	1.09	116.23 - 120.51
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			
	Females		
1	98.49	4.32	90.02 - 106.96
2	99.11	2.43	94.35 - 103.87
3	108.15	4.40	99.53 - 116.75
4	112.22	2.31	107.69 - 116.75
5	116.78	1.55	113.74 - 119.82
Groups 4 and 5 differ significantly from Groups 1, 2			
	Total Students		
1	98.35	2.75	92.96 - 103.74
2	100.13	1.62	96.96 - 103.31
3	106.29	2.17	102.04 - 110.54
4	114.72	1.35	112.07 - 117.37
5	117.79	.90	116.03 - 119.55
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			

The distributions for grade-point averages diminished in number as the semesters in attendance increased. It will be readily seen that for the first semester, five groups would be tested for homogeneity. For the second semester four groups would be tested, as the one semester group would have fallen out. Similarly, for the third semester,

TABLE 13

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE CRT-S TEST

Males			
No significant differences in means.			
Females			
No significant differences in means.			
Total Students			
1	20.56	1.37	17.87 - 23.25
2	23.35	.86	21.66 - 25.04
3	27.46	1.59	24.34 - 30.58
4	30.86	.94	29.02 - 32.70
5	31.92	.61	30.72 - 33.12

Group 3 differs significantly from Group 1.
Group 4 differs significantly from Groups 1 and 2.
Group 5 differs significantly from Groups 1, 2, and 3.

three groups would be tested; for the fourth semester, two groups would be tested for homogeneity. There would be no test for the fifth semester as only one group of the study would be in attendance, and thus there would be no basis of comparison.

The significant chi-square values for grade-point distributions are shown in Tables 18 to 21. Chi-square values, as previously explained, were deemed significant if the z value could not have occurred except by chance alone more than five times in 100.

The resulting determination of the standard error of the means and the fiducial limits of the means for the grade-point averages are shown in Tables 22 to 25 for semesters one, two, three, and four, respectively. As explained in the preceding paragraph, no test was possible for the fifth semester.

The procedure and computation used in the processing of grade-point distributions was exactly the same as for placement-test distributions, and as demonstrated earlier in the case of the ACE-T test.

TABLE 14

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE CRT-V TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
1	27.15	2.09	23.05 - 31.25
2	26.77	.94	24.93 - 28.61
3	27.05	1.42	24.27 - 29.83
4	32.53	.81	30.94 - 34.12
5	36.64	.53	35.52 - 37.76
Group 4 differs significantly from Groups 2 and 3. Group 5 differs significantly from Groups 1, 2, 3, and 4.			
	Females		
1	24.35	1.90	20.63 - 28.07
2	28.47	1.09	26.33 - 30.61
3	31.00	2.17	26.75 - 35.25
4	33.73	1.09	31.59 - 35.87
5	33.84	.75	32.37 - 35.31
Groups 4 and 5 differ significantly from Groups 1 and 2.			
	Total Students		
1	25.79	1.42	23.01 - 28.57
2	27.51	.72	26.10 - 28.92
3	28.29	1.20	25.94 - 30.64
4	32.85	.65	31.58 - 34.12
5	33.08	.46	32.18 - 32.98
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			

SUMMARY OF RESULTS FOR THE PLACEMENT TESTS

On the basis of non-significant chi-square values shown in Table 8, it was possible to make the followng statements regarding placement-test scores:

TABLE 15

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE CET-S TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
No significant differences in means			
	Females		
1	14.88	1.71	11.53 - 18.23
2	19.57	.98	17.65 - 21.49
3	17.65	1.88	13.97 - 21.33
4	21.84	1.06	19.76 - 23.92
5	23.15	.68	21.82 - 24.48
Group 4 differs significantly from Group 1. Group 5 differs significantly from Groups 1, 2, and 3.			
	Total Students		
No significant differences in means.			

1. No significant differences in means existed on the ACE-Q test for females attending the University one, two, three, four, or five semesters.

2. No significant differences in means existed on the ACE-L test for females attending the University one, two, three, four, or five semesters.

3. No significant differences in means existed on the CRT-S test for males attending the University one, two, three, four, and five semesters.

4. No significant differences in means existed on the CRT-S test for females attending the University one, two, three, four, or five semesters.

5. No significant differences existed in means on the CET-S test for males attending the University one, two, three, four, and five semesters.

TABLE 16

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE CET-U TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{M}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
	No significant differences in means.		
	Females		
	No significant differences in means.		
	Total Students		
1	75.87	3.58	68.85 - 82.89
2	86.64	2.00	82.72 - 90.56
3	82.04	2.90	76.36 - 87.72
4	100.99	1.83	97.43 -104.58
5	103.38	1.10	101.22 -105.54
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			

6. No significant differences existed in means on the CET-S test for all students attending the University one, two, three, four, or five semesters.

7. No significant differences existed in means on the CET-U test for males attending the University one, two, three, four, and five semesters.

8. No significant differences existed in means on the CET-U test for females attending the University one, two, three, four, and five semesters.

On the basis of data presented in Tables 10-17, it was possible to make the following statements regarding placement-test scores indicating significant differences in means:

1. Significant differences in means on the ACE-Q test existed for males as follows: Group 4 had a significantly higher mean than did Groups 1 and 2. Group 5 had a significantly higher mean than did Groups 1, 2, and 3.

TABLE 17

SIGNIFICANCE OF DIFFERENCES IN MEANS ON THE KU-M TEST

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
1	41.49	1.59	38.37 - 44.61
2	44.34	1.31	41.77 - 46.91
3	51.26	1.67	47.99 - 54.53
4	54.98	.92	53.18 - 56.78
5	54.93	.61	53.73 - 56.13
Groups 3, 4, and 5 differ significantly from Groups 1 and 2.			
	Females		
1	37.76	2.08	33.68 - 41.84
2	38.95	1.15	36.70 - 41.20
3	41.12	2.43	36.36 - 45.88
4	46.27	1.32	43.68 - 48.86
5	47.53	.84	45.88 - 49.18
Groups 4 and 5 differ significantly from Groups 1 and 2.			
	Total Students		
1	39.76	1.30	37.21 - 42.31
2	41.93	.90	40.17 - 43.69
3	48.08	1.46	45.22 - 50.94
4	51.81	.80	50.24 - 53.38
5	53.84	.54	52.78 - 54.90
Groups 3 and 4 differ significantly from Groups 1 and 2. Group 5 differs significantly from Groups 1, 2, and 3.			

2. Significant differences in means on the ACE-Q test existed for all students as follows: Group 4 had a significantly higher mean than Groups 1 and 2. Group 5 had a significantly higher mean than did Groups 1, 2, and 3.

TABLE 18

HOMOGENEITY OF FREQUENCY DISTRIBUTIONS FOR GRADE-POINT AVERAGES FOR THE FIRST SEMESTER FOR STUDENTS ATTENDING THE UNIVERSITY ONE, TWO, THREE, FOUR, AND FIVE SEMESTERS

Group	Chi-Square	Degrees of Freedom	Probability
Males	13.06	64	$P<.0002$
Females	10.46	64	$P<.0002$
Total Students	18.06	64	$P<.0002$

TABLE 19

HOMOGENEITY OF FREQUENCY DISTRIBUTIONS FOR GRADE-POINT AVERAGES FOR THE SECOND SEMESTER FOR STUDENTS ATTENDING THE UNIVERSITY TWO, THREE, FOUR, AND FIVE SEMESTERS

Group	Chi-Square	Degrees of Freedom	Probability
Males	12.32	48	$P<.0002$
Females	7.42	48	$P<.0002$
Total Students	15.16	48	$P<.0002$

TABLE 20

HOMOGENEITY OF FREQUENCY DISTRIBUTIONS FOR GRADE-POINT AVERAGES FOR THE THIRD SEMESTER FOR STUDENTS ATTENDING THE UNIVERSITY THREE, FOUR, AND FIVE SEMESTERS

Group	Chi-Square	Degrees of Freedom	Probability
Males	8.80	32	$P<.0002$
Females	1.33	32	$P>.05$
Total Students	8.15	32	$P<.0002$

3. Significant differences in means on the ACE-L test existed for males as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

4. Significant differences in means on the ACE-L test existed for all students as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

TABLE 21

HOMOGENEITY OF FREQUENCY DISTRIBUTIONS FOR GRADE-POINT AVERAGES FOR THE FOURTH SEMESTER FOR STUDENTS ATTENDING THE UNIVERSITY FOUR AND FIVE SEMESTERS

Group	Chi-Square	Degrees of Freedom	Probability
Males	2.44	16	P< .02
Females	2.30	16	P< .03
Total Students	2.54	16	P< .02

5. Significant differences in means on the ACE-T test existed for males as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

6. Significant differences in means on the ACE-T test existed for females as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1 and 2.

7. Significant differences in means on the ACE-T test existed for all students as follows: The means of Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

8. Significant differences in means on the CRT-S test existed for all students as follows: The mean for Group 3 was significantly higher than that for Group 1. The mean for Group 4 was significantly higher than those for Groups 1 and 2. The mean for Group 5 was significantly higher than those for Groups 1, 2, and 3.

9. Significant differences in means on the CRT-V test existed for males as follows: The mean for Group 4 was significantly higher than those for Groups 2 and 3, but not than that for Group 1. The mean of Group 5 was significantly higher than those for Groups 1, 2, 3, and 4.

10. Significant differences in means on the CRT-V test existed for females as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1 and 2.

11. Significant differences in means on the CRT-V test existed for all students as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

12. Significant differences in means on the CET-S test existed for females as follows: The mean for Group 4 was significantly higher than that for Group 1. The mean for Group 5 was significantly higher than those for Groups 1, 2, and 3.

TABLE 22

SIGNIFICANCE OF DIFFERENCES IN MEANS ON GRADE-POINT AVERAGES FOR THE FIRST SEMESTER

Groups by Total Semesters in Attendance	M	SEM	Fiducial Limits of the Mean at the 5 Per Cent Level
	Males		
1	1.178	.104	.974 - 1.382
2	1.612	.068	1.479 - 1.745
3	1.678	.084	1.514 - 1.842
4	2.362	.057	2.251 - 2.473
5	2.518	.035	2.450 - 2.586
Groups 2 and 3 differ significantly from Group 1. Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			
	Females		
1	1.515	.141	1.239 - 1.791
2	1.866	.076	1.717 - 2.015
3	1.985	.162	1.667 - 2.303
4	2.591	.078	2.438 - 2.744
5	2.649	.043	2.565 - 2.733
Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			
	Total Students		
1	1.336	.088	1.164 - 1.508
2	1.729	.051	1.630 - 1.828
3	1.771	.078	1.618 - 1.924
4	2.445	.045	2.357 - 2.533
5	2.566	.027	2.518 - 2.619
Groups 2 and 3 differ significantly from Group 1. Groups 4 and 5 differ significantly from Groups 1, 2, and 3.			

13. Significant differences in means on the CET-U test existed for all students as follows: The means for Group 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

14. Significant differences in means on the KU-M test existed for

TABLE 23

SIGNIFICANCE OF DIFFERENCES IN MEANS ON GRADE-POINT AVERAGES FOR THE SECOND SEMESTER

Groups by Total Semesters in Attendance	M	SEM	Fiducial Limits of the Means at the 5 Per Cent Level
	Males		
2	1.478	.074	1.333 - 1.623
3	1.795	.096	1.607 - 1.983
4	2.277	.054	2.172 - 2.382
5	2.524	.038	2.450 - 2.598
Group 4 differs significantly from Groups 2 and 3. Group 5 differs significantly from Groups 2, 3, and 4.			
	Females		
2	1.825	.082	1.664 - 1.986
3	2.091	.140	1.817 - 2.365
4	2.586	.068	2.453 - 2.719
5	2.684	.045	2.596 - 2.772
Groups 4 and 5 differ significantly from Groups 2 and 3.			
	Total Students		
2	1.638	.056	1.529 - 1.747
3	1.871	.080	1.714 - 2.028
4	2.389	.043	2.305 - 2.473
5	2.583	.029	2.527 - 2.639
Group 4 differs significantly from Groups 2 and 3. Group 5 differs significantly from Groups 2, 3, and 4.			

males as follows: The means for Groups 3, 4, and 5 were significantly higher than those for Groups 1 and 2.

15. Significant differences in means on the KU-M test existed for females as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1 and 2.

16. Significant differences in means on the KU-M test existed for all students as follows: The means for Groups 3 and 4 were signifi-

TABLE 24

SIGNIFICANCE OF DIFFERENCES IN MEANS ON GRADE-POINT AVERAGES FOR THE THIRD SEMESTER

Groups by Total Semesters in Attendance	M	SEM	Fiducial Limits of the Means at the 5 Per Cent Level
	Males		
3	1.433	.098	1.241 - 1.625
4	2.225	.050	2.127 - 2.323
5	2.439	.039	2.363 - 2.515
Groups 4 and 5 differ significantly from Group 3. Group 5 differs significantly from Group 4.			
	Females		
No significant differences in means.			
	Total Students		
3	1.631	.092	1.451 - 1.811
4	2.392	.042	2.310 - 2.474
5	2.557	.028	2.503 - 2.611
Groups 4 and 5 differ significantly from Group 3. Group 5 differs significantly from Group 4.			

cantly higher than those for Groups 1 and 2. The mean for Group 5 was significantly higher than those for Groups 1, 2, and 3.

It is thus seen that of the 24 tests for homogeneity of means in placement-test scores, eight showed no significant differences and 16 did show significant differences in means. Among male students, five tests showed significant differences, and three showed none. Among female students, four showed significant differences, and four showed none. Among the total groups of students, results were more conclusive. In only one test, the CET-S test, was there an absence of significant difference in means among the semester groups.

Of the eight tests, three showed significant differences in all three groups, males, females, and total students. These were the ACE-T, the CRT-V, and the KU-M tests.

TABLE 25

SIGNIFICANCE OF DIFFERENCES IN MEANS ON GRADE-POINT AVERAGES FOR THE FOURTH SEMESTER

Groups by Total Semesters in Attendance	M	$SE_{\bar{x}}$	Fiducial Limits of the Means at the 5 Per Cent Level
	Males		
4	2.179	.065	2.052 - 2.306
5	2.479	.038	2.405 - 2.553
Group 5 differs significantly from Group 4.			
	Females		
4	2.561	.070	2.424 - 2.698
5	2.724	.042	2.642 - 2.806
No significant differences in means.			
	Total Students		
4	2.318	.050	2.220 - 2.416
5	2.568	.029	2.512 - 2.624
Group 5 differs significantly from Group 4.			

SUMMARY OF RESULTS FOR GRADE-POINT AVERAGES

Tests of homogeneity on grade-point averages showed a higher percentage of significant differences than did the tests of homogeneity on placement tests. Of the 12 homogeneity tests run, one failed definitely to show significant differences, and the result of a second was doubtful. The results are shown in Tables 18-25.

The test which showed no differences in means of grade-point averages was that for female students of the various semester groups during the third semester.

The test, which is labeled doubtful, is that for females during the fourth semester. The chi-square value of 2.30 was declared to be defi-

nitely significant inasmuch as reference to the normal curve yielded a probability of less than .03, as shown in Table 21. However, reference to Table 25 shows a slight overlap of the fiducial limits of the means at the 5 per cent level.

For the 10 tests of homogeneity of grade-point averages for which significant differences were reported, it is possible to make the following statements:

1. Significant differences in means of grade-point averages for the first semester existed for male students as follows: The means for Groups 2 and 3 were significantly higher than that for Group 1. The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

2. Significant differences in means of grade-point averages for the first semester existed for female students as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

3. Significant differences in means of grade-point averages for the first semester existed for all students as follows: The means for Groups 2 and 3 were significantly higher than that for Group 1. The means for Groups 4 and 5 were significantly higher than those for Groups 1, 2, and 3.

4. Significant differences in means of grade-point averages for the second semester existed for males as follows: The mean for Group 4 was significanty higher than those for Groups 2, 3, and 4.

5. Significant differences in means of grade-point averages for the second semester existed for females as follows: The means for Groups 4 and 5 were significantly higher than those for Groups 2 and 3.

6. Significant differences in means of grade-point averages for the second semester existed for all students as follows: The mean for Group 4 was significantly higher than those for Group 2 and 3. The mean for Group 5 was significantly higher than those for Groups 2, 3, and 4.

7. Significant differences in means of grade-point averages for the third semester existed for males as follows: The mean for Group 4 was significantly higher than that of Group 3. The mean for Group 5 was significantly higher than those for Groups 3 and 4.

8. Significant differences in means of grade-point averages for the third semester existed for all students as follows: The mean for Group 4 was significantly higher than that for Group 3. The mean for Group 5 was significantly higher than those for Groups 3 and 4.

9. Significant differences in means of grade-point averages for the

fourth semester existed for males as follows: The mean for Group 5 was significantly higher than that of Group 4.

10. Significant differences in means of grade-point averages for the fourth semester was doubtful for females, as pointed out previously in this section.

11. Significant differences in means of grade-point averages for the fourth semester existed for all students as follows: The mean for Group 5 was significantly higher than that for Group 4.

PART IV
Summary, Implications, and Limitations of the Study

Summary and Implications of the Findings

The present investigation was a study of the persistence in college attendance of students who entered the University of Kansas in the fall of 1954. The purpose has been: (1) to find relationships between the length of stay in school and scores made on placement tests given before enrollment, and (2) to find relationships between length of stay in school and grade-point averages. The study covered the first five semesters of attendance. The findings of the present study, reached through application of appropriate statistical techniques, may be summarized as follows:

1. Placement-test mean scores for the sexes indicated that probably a more select group of females than males enrolled at the University. Males were higher than females in mean scores on only the ACE-Q, ACE-T, and KU-M tests. Female mean scores were higher than those of the males in the other five test scores.

2. The variations between semester groups on the basis of measures of central tendency on the placement tests indicated that the students who tended to stay in school scored higher, but this evidence was not overwhelming. In eleven cases, means of succeeding semester groups were lower than those of preceding groups, and the same situation was found to exist in the case of 18 medians. In this aberration of progressive increase in mean and median scores, the most exceptions were found to exist with three-semester groups. It may be an indication that both males and females, but particularly males, tended to stay in school until after enrollment for the third semester for reasons other than academic interests. Measures of central tendency also indicated that selection on the basis of academic aptitude had probably been in operation before the fifth semester, as small differences seemed to exist between fourth and fifth semester groups.

3. Of the 24 tests made for homogeneity of semester groups on the placement tests, fully a third, or eight tests, showed no significant differences. On only three placement tests were significant differences discovered for all semester groups, for males, females, and total students. One of these tests was the ACE-T test, which fact may be of some import. The other two were the KU-M test and the CRT-V tests.

4. A slightly greater number of significant differences existed among male semester groups than among female semester groups on the eight placement tests.

5. The breaking point for significance of differences among means on the placement tests definitely seemed to exist between the three and four semester groups of both sexes. Of the 24 homogeneity tests, there were nine cases in which significant differences among means existed between semester Groups 4 and 5 on one hand and Group 3 on the other. In addition, Group 5 showed significantly higher means than did Group 3 on five tests. On the other hand, Group 3 showed significantly higher means than did Group 2 on only two of the 24 tests. Groups 3 showed significantly higher means than did Group 1 on only three tests. On only one test was there a significant difference in means between Groups 4 and 5. A definite cleavage of placement-test mean scores seems to be evident between Groups 1, 2, and 3 on the one hand, and Groups 4 and 5 on the other hand. The picture held equally true for both sexes.

6. The ACE-T, the CRT-V, and the KU-M tests tended to show the greatest variability among semester groups. The CET-S, the CET-U and the CRT-S showed the least variability. The latter tests would likely be the least selective for purposes of predicting persistence in college.

7. Male scores tended to form platykurtic distributions, or showed more variability. Female scores tended to form leptokurtic distributions or clustered nearer to their means.

8. The tests over-all indicated that those testing verbal aptitudes tended to form positively skewed distributions, while the tests which tested quantitative aptitudes tended to form negatively skewed distributions. These trends occurred for both sexes.

9. Only the Semester Group 1 showed strong positive skewness on all tests.

10. For every grade-point average distribution, the female means were higher than male means when averages were computed on the basis of all students regardless of the length of stay in school. Women did better academic work than did men at the University, for the first

five semesters covered in the study, if grade-point averages may be considered as indicative of the quality of academic work.

11. For each of the semesters covered, the groups which were to remain for progressively more semesters recorded higher mean grad-point averages. This fact points up a rather striking relationship between grade-point averages for a given semester and the length of stay in school. This held true without exception for each sex, computed separately, and for the entire total of students. In other words, those students who tended to remain in school tended to have better grades than those who dropped out.

12. Of the 12 tests for homogeneity of grade-point average distributions, only two failed to indicate differences among means, and one of these two was doubtful. Both of these sets of distributions which were apparently homogeneous, were female distributions.

13. Female distributions of grade-point averages were consistently negatively skewed for all semesters included in the study, while male distributions were preponderantly positively skewed, bearing out the evidence of higher academic achievement of women over men.

14. Tests for homogeneity of distributions of grade-point averages for the various semester groups indicated, as did those of placement-test scores, that the breaking point for significance of differences among means on academic achievement was shown to be between the Semester Groups 1, 2, and 3 on the one hand and Groups 4 and 5 on the other.

15. Pending further study, the investigation tended to show that grade-point averages were more valid than placement-test scores for predicting persistence in attendance at the University.

16. Tests for homogeneity of distributions of both placement-test scores and grade-point averages showed more variability after three semesters of attendance. This may indicate that attendance at the University for the first three semesters is motivated to a greater degree by factors other than those indicated by grade-point averages.

17. Women are more likely to leave school for reasons other than lack of academic aptitude than are men.

Limitations of the Study

The study was obviously limited by the fact that the last three semesters of the school history of the students involved were not included notwithstanding the apparent trends established within the scope of this project. Future studies might well throw more light on the persistence patterns of the students if eight semesters of attendance were included.

A thorough investigation of drop-outs would do much to supplement the findings of the present study. Reasons for discontinuing school after successive semesters might throw more light on apparent lack of variability between semester groups. Obviously many students, especially women, dropped out of school for reasons other than academic inaptitude. The entire relationship of persistence in attendance to placement-test scores and to grade-point averages might be changed if drop-out factors were included in the study. Such findings would have great value in counseling students and in identifying potential drop-outs.

Definite conclusions as to apparent sex differences in achievement cannot be drawn until relationships between achievement and ability are found. The sex differences in achievement as shown by the placement-test scores and by the grade-point averages might depend on factors which affect the motivation of students. Extraneous variables must be taken into account before definite conclusions can be drawn. Considering the sex differences in achievement, it would be well if studies were made, considering the sexes separately, of the correlation between ability and achievement.

The present study might also have been limited by the fact that all students were considered as a single group without regard to the school or college of the University in which they were enrolled. If we are to believe that various avenues of learning require somewhat different inclinations and abilities for success, the present study would not show true persistence patterns. As has been stated, the great unmeasured variable in all of the present inquiry is motivation which moves students to academic achievement, and even the will to continue in school. Consideration of this problem by separating students according to the various schools and colleges in which they are enrolled may be necessary in order to reveal significant findings.

It will probably be shown, through the findings of this study and others already made and those projected for the future, that selection of students for college by various means has been and is being made. One may assume that not the least of the selective factors operating is that of socio-economic status and background. This factor, obviously, was not touched upon in the present study. Isolation and evaluation of selection techniques will do much to answer questions for the administration of college planning and guidance programs, as well as for the administration of scholarships and other related projects.

Many questions remain to be raised and answered before the final solution is found to the problem of why students achieve success and persist in school.

TABLE 1

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS FOR THE ACE-Q TEST

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
1	41	40.293	39.400	9.96	55.399	26.650	45.625	33.850	.268	.204
2	125	42.640	45.250	12.60	57.250	23.125	52.000	34.750	-.621	.252
3	60	45.150	46.375	9.72	55.833	32.500	52.499	40.000	-.378	.267
4	158	48.278	48.643	9.54	60.049	36.433	55.000	42.368	-.113	.267
5	363	50.124	50.882	10.32	62.382	36.869	57.147	43.605	-.220	.265
					Females					
1	37	40.324	42.625	12.75	53.800	21.550	51.050	32.550	-.543	.286
2	109	39.615	41.050	10.68	52.257	24.640	47.212	33.481	-.404	.248
3	26	43.923	45.250	10.08	54.700	28.900	50.125	37.000	-.395	.254
4	92	43.848	43.577	9.84	55.840	32.600	50.500	38.167	.082	.265
5	210	45.443	46.900	10.20	58.167	31.500	52.589	38.600	-.429	.262
					Total Students					
1	78	40.308	40.750	11.37	54.560	25.300	49.250	33.438	-.116	.269
2	234	41.231	43.060	11.85	55.771	24.025	49.750	33.925	-.463	.249
3	86	44.779	46.000	9.84	55.720	30.700	51.664	39.250	-.371	.248
4	250	46.648	46.857	9.90	58.999	34.954	53.565	40.480	-.063	.272
5	573	48.408	48.098	10.53	60.116	33.067	54.151	41.627	.089	.231

TABLE 2

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS FOR THE ACE-L TEST

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
1	43	57.488	58.375	14.35	74.875	38.800	67.750	46.188	-.183	.298
2	124	58.678	59.682	13.70	76.318	38.929	68.167	50.071	-.218	.242
3	59	60.271	59.909	12.65	76.667	43.400	69.972	50.607	.085	.290
4	158	68.082	67.750	12.85	84.269	49.750	77.375	56.895	.077	.296
5	365	68.384	67.450	13.35	86.396	51.683	78.028	58.194	.208	.285
					Females					
1	37	57.649	57.125	15.80	75.625	35.750	66.292	48.063	.098	.228
2	110	59.909	59.179	17.55	81.500	39.357	69.536	48.750	.124	.246
3	26	63.038	66.500	15.75	88.250	40.833	72.333	50.250	-.659	.232
4	92	68.076	67.214	15.05	87.833	51.577	78.000	57.125	.173	.287
5	210	71.167	69.726	15.15	92.056	52.816	81.656	60.006	.285	.275
					Total Students					
1	80	57.563	57.570	15.05	75.250	38.167	67.214	47.214	-.037	.269
2	234	59.256	59.278	15.65	78.000	39.143	68.904	49.521	-.003	.249
3	85	61.118	60.818	13.75	79.000	42.571	70.750	50.528	.065	.277
4	250	67.600	67.553	14.00	85.184	50.071	77.583	56.963	.010	.293
5	575	69.400	68.321	14.10	88.539	52.042	79.000	59.323	.229	.269

TABLE 3

MEASURES OF CENTRAL TENDENCIES, VARIABILITY, SKEWNESS, AND KURTOSIS FOR THE ACE-T TEST

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
1	41	98.219	96.375	22.35	129.000	70.000	114.083	83.250	.246	.261
2	124	101.315	107.192	24.00	128.333	64.900	117.357	88.667	-.735	.227
3	59	105.475	106.583	18.80	127.125	81.750	119.679	94.250	-.177	.280
4	158	115.924	116.286	20.65	139.667	87.885	132.000	100.182	-.053	.307
5	364	118.374	120.114	20.70	143.750	92.500	133.094	104.339	-.252	.280
					Females					
1	37	98.487	100.750	25.90	127.750	58.000	117.250	82.313	-.261	.250
2	109	99.110	99.188	25.25	126.333	67.400	115.750	85.438	-.009	.257
3	26	108.154	111.167	22.00	136.833	72.750	127.000	90.750	-.411	.282
4	92	112.217	112.000	22.05	139.167	82.500	124.500	101.167	.029	.205
5	209	116.785	116.554	22.30	146.778	87.636	132.375	101.688	.030	.259
					Total Students					
1	78	98.346	98.250	24.10	128.167	66.500	116.073	82.714	.012	.270
2	233	100.133	103.471	24.60	127.665	66.150	116.762	86.514	-.407	.245
3	85	106.294	108.111	19.90	130.750	78.250	120.750	93.250	-.274	.261
4	250	114.720	114.700	21.35	139.500	87.167	129.105	100.529	.002	.273
5	573	117.794	118.164	21.30	144.870	90.804	132.923	103.599	-.052	.271

TABLE 4

SUMMARY STATISTICS ON DISTRIBUTIONS OF GRADE-POINT AVERAGES FOR THE FIRST SEMESTER

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
1	43	1.178	1.170	.68	2.164	.215	1.573	.665	.044	.234
2	127	1.612	1.558	.77	2.676	.598	2.211	1.024	.194	.286
3	60	1.678	1.602	.65	2.578	.845	2.045	1.281	.369	.222
4	164	2.362	2.358	.73	3.262	1.305	2.916	1.927	.019	.253
5	365	2.586	2.520	.68	3.434	1.639	3.059	2.045	.264	.282
					Females					
1	38	1.515	1.578	.86	2.455	.238	2.183	.870	-.244	.295
2	110	1.866	1.877	.80	2.995	.720	2.349	1.308	-.037	.228
3	26	1.985	2.120	.81	3.095	1.103	2.620	1.183	-.481	.360
4	94	2.591	2.620	.76	3.520	1.670	3.076	2.197	-.118	.237
5	210	2.649	2.650	.63	3.437	1.881	3.072	2.202	-.007	.278
					Total Students					
1	81	1.336	1.302	.79	2.349	.225	2.042	.696	.113	.316
2	237	1.729	1.763	.79	2.793	.662	2.243	1.117	-.113	.262
3	86	1.771	1.683	.72	2.770	.895	2.263	1.253	.375	.270
4	258	2.446	2.453	.73	3.318	1.366	2.991	2.039	-.031	.243
5	575	2.566	2.565	.66	3.435	1.706	3.064	2.102	.045	.277

TABLE 5

SUMMARY STATISTICS ON DISTRIBUTIONS OF GRADE-POINT AVERAGES FOR THE SECOND SEMESTER

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
2	127	1.478	1.428	.84	2.670	.316	2.084	.858	.178	.259
3	60	1.795	1.745	.74	2.745	.912	2.245	1.308	.202	.256
4	164	2.277	2.555	.69	3.179	1.438	2.685	1.863	.130	.238
5	365	2.524	2.538	.73	3.468	1.567	3.019	2.076	-.082	.247
					Females					
2	110	1.825	2.015	.86	2.995	.495	2.370	1.211	-.662	.232
3	26	2.091	1.870	.70	3.170	1.295	2.433	1.620	.942	.216
4	94	2.586	2.591	.66	3.389	1.665	3.105	2.191	-.025	.264
5	210	2.684	2.675	.66	3.574	1.836	3.180	2.193	.045	.286
					Total Students					
2	237	1.639	1.656	.87	2.809	.376	2.223	1.008	-.068	.248
3	86	1.872	1.841	.74	2.945	1.014	2.283	1.441	.121	.217
4	258	2.389	2.379	.70	3.268	1.518	2.891	1.959	.085	.265
5	575	2.584	2.591	.71	2.518	1.663	3.083	2.121	-.042	.258

TABLE 6

SUMMARY STATISTICS ON DISTRIBUTIONS OF GRADE-POINT AVERAGES FOR THE THIRD SEMESTER

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
3	60	1.433	1.320	.76	2.495	.495	1.745	.995	.434	.187
4	164	2.225	2.216	.65	3.112	1.351	2.647	1.783	.046	.247
5	365	2.439	2.453	.75	3.429	1.487	2.956	2.017	-.040	.244
					Females					
3	26	2.091	2.183	.86	3.112	.645	2.651	1.683	-.313	.197
4	94	2.684	2.724	.63	3.510	2.002	3.159	2.237	-.190	.306
5	210	2.763	2.729	.61	3.587	1.995	3.232	2.327	.147	.283
					Total Students					
3	86	1.632	1.520	.85	2.778	.525	2.231	1.068	.388	.257
4	258	2.392	2.381	.68	3.284	1.506	2.898	2.013	.044	.251
5	575	2.558	2.571	.69	3.504	1.606	3.081	2.109	-.043	.256

TABLE 7

SUMMARY STATISTICS ON DISTRIBUTIONS OF GRADE-POINT AVERAGES FOR THE FOURTH SEMESTER

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
4	164	2.179	2.285	.84	3.213	.965	2.761	1.695	-.392	.236
5	365	2.479	2.443	.73	3.470	1.563	3.001	2.029	.164	.253
					Females					
4	94	2.562	2.584	.68	3.374	1.678	3.081	2.198	-.088	.260
5	210	2.724	2.686	.61	3.495	1.995	3.154	2.336	.147	.270
					Total Students					
4	258	2.319	2.399	.81	3.276	1.165	2.900	1.893	-.296	.239
5	575	2.568	2.561	.70	3.481	1.663	3.073	2.116	.042	.260

TABLE 8

SUMMARY STATISTICS ON DISTRIBUTIONS OF GRADE-POINT AVERAGES FOR THE FIFTH SEMESTER

Groups Sem. in Attendance	N	M	Md	S.D.	P_{90}	P_{10}	P_{75}	P_{25}	Sk	Ku
					Males					
5	365	2.429	2.474	.81	3.521	1.370	2.997	1.914	-.148	.248
					Females					
5	210	2.868	2.870	.56	3.608	2.145	3.261	2.525	-.053	.253
					Total Students					
5	575	2.589	2.656	.76	3.560	1.572	3.108	2.125	-.236	.246

TABLE 9

TESTING FOR HOMOGENEITY OF FREQUENCY DISTRIBUTIONS ON THE ACE-T TEST FOR STUDENTS WHO ATTENDED THE UNIVERSITY THE NUMBER OF SEMESTERS INDICATED

Step Interval	Groups by Semester in Attendance: One F	One F^2	Two F	Two F^2	Three F	Three F^2	Four F	Four F^2	Five F	Five F^2	N	1/N
175-179	0	0	0	0	0	0	0	0	3	9	3	.3333
170-174	0	0	0	0	0	0	1	1	4	16	5	.2000
165-169	0	0	0	0	0	0	0	0	1	1	1	1.0000
160-164	0	0	0	0	0	0	2	4	4	16	6	.6667
155-159	1	1	3	9	0	0	10	100	8	64	22	.0455
150-154	0	0	2	4	0	0	2	4	16	256	20	.0500
145-149	0	0	1	1	1	1	2	4	23	529	27	.0370
140-144	1	1	5	25	1	1	8	64	23	529	38	.0263
135-139	2	4	6	36	5	25	20	400	48	2304	81	.0123
130-134	3	9	3	9	2	4	16	256	42	1764	66	.0152
125-129	3	9	9	81	7	49	19	361	37	1369	75	.0133
120-124	5	25	18	324	7	49	21	441	62	3844	113	.0088
115-119	7	49	21	441	9	81	25	625	58	3364	120	.0083
110-114	5	25	24	576	8	64	24	576	48	2304	109	.0092
105-109	7	49	21	441	9	81	24	576	45	2025	106	.0094
100-104	3	9	17	289	4	16	17	289	43	1849	84	.0119
95-99	8	64	14	196	9	81	14	196	30	900	75	.0133
90-94	5	25	20	400	7	49	13	169	28	784	73	.0137
85-89	6	36	18	324	4	16	15	225	18	324	61	.0164
80-84	7	49	6	36	3	9	4	16	9	81	29	.0345
75-79	5	25	8	64	2	4	5	25	6	36	26	.0385
70-74	1	1	7	49	5	25	2	4	8	64	23	.0435
65-69	2	4	10	100	0	0	4	16	4	16	20	.0500
60-64	2	4	2	4	0	0	0	0	2	4	6	.1667

TABLE 9 *(continued)*

55-59	1	1	5	25	1	1	2	4	1	1	10	.1000
50-54	0	0	5	25	1	1	0	0	2	4	8	.1250
45-49	2	4	4	16	0	0	0	0	0	0	6	.1667
40-44	1	1	2	4	0	0	0	0	0	0	3	.3333
35-39	1	1	0	0	0	0	0	0	0	0	1	1.0000
30-34	0	0	2	4	0	0	0	0	0	0	2	.5000
N	78		235		85		250		573		1219	
1/N	.0128		.0043		.0018		.0040		.0017			

TABLE 10

OBTAINING THE F^2 (1/Tr)(1/Tc) FOR THE FIRST SEMESTER GROUP ON THE ACE-T TEST

Intervals Containing Frequencies	F^2	1/Tr	1/Tc	F^2(1/Tr)(1/Tc)
155-159	1	.0128	.0455	.0006
140-144	1	.0128	.0263	.0003
135-139	4	.0128	.0123	.0006
130-134	9	.0128	.0152	.0018
125-129	9	.0128	.0133	.0015
120-124	25	.0128	.0088	.0028
115-119	49	.0128	.0083	.0052
110-114	25	.0128	.0092	.0029
105-109	49	.0128	.0094	.0059
100-104	9	.0128	.0119	.0014
95-99	64	.0128	.0133	.0109
90-94	25	.0128	.0037	.0044
85-89	36	.0128	.0164	.0076
80-84	49	.0128	.0345	.0216
75-79	25	.0128	.0385	.0123
70-74	1	.0128	.0435	.0006
65-69	4	.0128	.0500	.0026
60-64	4	.0128	.1667	.0085
55-59	1	.0128	1.0000	.0128
45-49	4	.0128	.1667	.0085
40-44	1	.0128	.3333	.0043
35-39	1	.0128	1.0000	.0128
Total				.1299

TABLE 11

OBTAINING THE F^2 (1/Tr)(1/Tc) FOR THE SECOND SEMESTER GROUP ON THE ACE-T TEST

Intervals Containing Frequencies	F^2	1/Tr	1/Tc	F^2(1/Tr)(1/Tc)
155-159	9	.0043	.0455	.0158
150-154	4	.0043	.0500	.0009
145-149	1	.0043	.0370	.0002
140-144	25	.0043	.0263	.0028
135-139	36	.0043	.0123	.0019
130-134	9	.0043	.0152	.0006
125-129	81	.0043	.0133	.0046
120-124	324	.0043	.0088	.0123
115-119	441	.0043	.0083	.0157
110-114	576	.0043	.0092	.0228
105-109	441	.0043	.0094	.0178
100-104	289	.0043	.0119	.0148
95-99	196	.0043	.0133	.0112
90-94	400	.0043	.0137	.0236
85-89	324	.0043	.0164	.0228
80-84	36	.0043	.0345	.0053
75-79	64	.0043	.0385	.0106
70-74	49	.0043	.0435	.0092
65-69	100	.0043	.0500	.0215
60-64	4	.0043	.1667	.0029
55-59	25	.0043	.1000	.0108
50-54	25	.0043	.1250	.0134
45-49	16	.0043	.1667	.0115
40-44	4	.0043	.3333	.0057
30-34	4	.0043	.5000	.0086
Total				.2673

TABLE 12

OBTAINING THE F^2 (1/Tr)(1/Tc) FOR THE THIRD SEMESTER GROUP ON THE ACE-T TEST

Intervals Containing Frequencies	F^2	1/Tr	1/Tc	F^2(1/Tr)(1/Tc)
145-149	1	.0118	.0370	.0004
140-144	1	.0118	.0263	.0003
135-139	25	.0118	.0123	.0036
130-134	4	.0118	.0152	.0003
125-129	49	.0118	.0133	.0077
120-124	49	.0118	.0088	.0051
115-119	81	.0118	.0083	.0079
110-114	64	.0118	.0092	.0069
109-109	81	.0118	.0094	.0090
100-104	16	.0118	.0119	.0022
95-99	81	.0118	.0133	.0127
90-94	49	.0118	.0137	.0079
85-89	16	.0118	.0164	.0031
80-84	9	.0118	.0345	.0037
75-79	4	.0118	.0385	.0018
70-74	25	.0118	.0435	.0128
55-59	1	.0118	.1000	.0012
50-54	1	.0118	.1250	.0015
Total				.0081

TABLE 13

OBTAINING THE F^2 (1/Tr)(1/Tc) FOR THE FOURTH SEMESTER GROUP ON THE ACE-T TEST

Intervals Containing Frequencies	F^2	1/Tr	1/Tc	F^2(1/Tr)(1/Tc)
170-174	1	.0040	.2000	.0008
160-164	4	.0040	.6667	.0107
155-159	100	.0040	.0455	.0182
150-154	4	.0040	.0500	.0008
145-149	4	.0040	.0370	.0006
140-144	64	.0040	.0263	.0067
135-139	400	.0040	.0123	.0197
130-134	256	.0040	.0152	.0156
125-129	361	.0040	.0138	.0192
120-124	441	.0040	.0088	.0155
115-119	625	.0040	.0083	.0208
110-114	576	.0040	.0092	.0212
105-109	576	.0040	.0094	.0217
100-104	289	.0040	.0119	.0138
95-99	196	.0040	.0133	.0104
90-94	169	.0040	.0137	.0093
85-89	225	.0040	.0164	.0148
80-84	16	.0040	.0345	.0022
75-79	25	.0040	.0385	.0039
70-74	4	.0040	.0435	.0007
65-59	16	.0040	.0500	.0032
55-59	4	.0040	.1000	.0016
Total				.2314

TABLE 14

OBTAINING THE F^2 (1/Tr)(1/Tc) FOR THE FIFTH SEMESTER GROUP ON THE ACE-T TEST

Intervals Containing Frequencies	F^2	1/Tr	1/Tc	F^2(1/Tr)(1/Tc)
175-179	9	.0017	.3333	.0051
170-174	16	.0017	.2000	.0054
165-169	1	.0017	1.0000	.0017
160-164	16	.0017	.6667	.0181
155-159	64	.0017	.0455	.0050
150-154	256	.0017	.0500	.0218
145-149	529	.0017	.0370	.0333
140-144	529	.0017	.0263	.0237
135-139	2304	.0017	.0123	.0482
130-134	1764	.0017	.0152	.0456
125-129	1369	.0017	.0133	.0310
120-124	3844	.0017	.0088	.0575
115-119	3364	.0017	.0083	.0475
110-114	2304	.0017	.0092	.0360
105-109	2025	.0017	.0094	.0324
100-104	1849	.0017	.0119	.0374
95-99	900	.0017	.0133	.0203
90-94	784	.0017	.0137	.0183
85-89	324	.0017	.0164	.0090
80-84	81	.0017	.0345	.0048
75-79	36	.0017	.0385	.0024
70-74	64	.0017	.0435	.0047
65-69	16	.0017	.0500	.0014
60-64	4	.0017	.1667	.0011
55-59	1	.0017	.1000	.0002
50-54	4	.0017	.1250	.0009
Total				.5128
Grand Total				1.2295

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